The Analysis of Student-Needs in Trigonometry Learning

Martyana Prihaswati [1] , Venissa Dian Mawarsari [2] , Iswahyudi Joko Suprayitno [3]
martyana@unimus.ac.id [1] , venissa@unimus.ac.id [2] , iswahyudi@unimus.ac.id [3]

University of Muhammadiyah Semarang , Jl. Kedungmundu Raya No. 22 Semarang [1.2 , 3]

Abstract. Trigonometry is one of supporting material for other courses, such as integral calculus, multivariable calculus, advanced calculus, algebraic structure, and differential equations. As a matter of fact, a trigonometric theory is an abstract material that is difficult to understand because not all students are familiar with the material. To cope with it, it is necessary to have a clear description of student needs in trigonometric learning so that the material learned effectively. The method used to obtain the description is need-analysis that use observation techniques and interviews with students as the object. The results are the students' way of thinking is not schematic yet with learning methods that use expository and monotonous methods, makes student motivation in trigonometric learning low so that reasoning ability and concept comprehension are also low. In conclusion, the needs of students in trigonometric learning are the innovative methods or learning media that can increase motivation and reasoning abilities and understanding the concepts.

Keywords: Trigonometry, Learning, Needs Analysis

1. Introduction

The objectives of National Education stated in Law number 20 of 2003 concerning National Education System Article 3 which states that national education aim is to develop the students potential to become human beings who believe in and fear God Almighty, have noble, healthy, knowledgeable, capable, creative, independent, and become citizens democratic and responsible [1]. So students are expected to have the skills to improve the quality of national education to meet the demands of the 21st century. To measure the education quality at the international level, Indonesia has been following the *Program for International Students Assessment* (PISA) since 2000. The main idea of PISA is the measurability of the results of the education system seen from student competency with the main concept is literacy. There are three types of literacy that are monitored by PISA. They are reading literacy, mathematical literacy, and scientific literacy.

PISA defines mathematical literacy as an individual's ability to formulate, use, and explain mathematics in various contexts [2]. Three main things are the main ideas of the concept of mathematical literacy, namely (1) the ability to formulate, apply, and interpret mathematics in various contexts; (2) involving mathematical reasoning and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena; and (3) the benefits of mathematical literacy ability which can help someone apply mathematics into the daily life as a form of constructive and reflective community involvement [3]. Based on data from the Organization for Economic Co-operation and Development (OECD) which houses PISA, Indonesia's mathematics literacy ranking is at the lowest level as shown in Figure 1. This becoming particular concern to Indonesian researchers to improve mathematical literacy from all aspects and material in mathematics.

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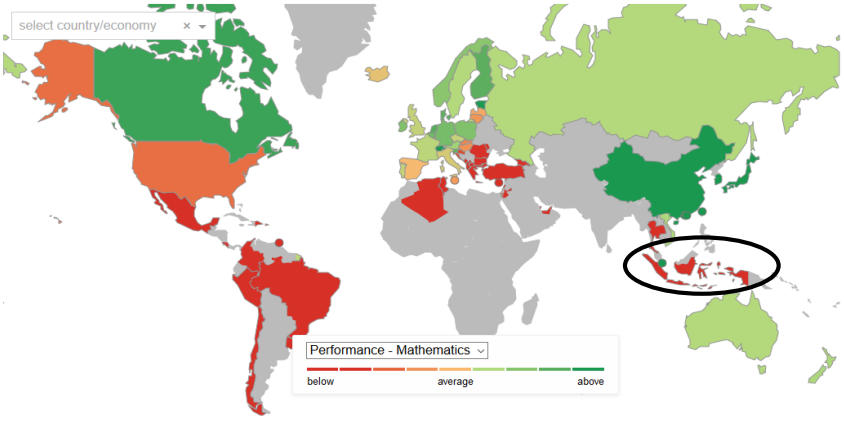

Fig 1. Map of the Distribution of Mathematics Literacy Levels in OECD Region Countries [4]

One of the factors causing the low mathematical literacy among students, they are not accustomed to facing problems that have contextual substance, demand reasoning, argumentation, and creativity in solving problems [5]. Mathematics learning in Indonesia generally emphasizes student learning outcomes without looking at the abilities involved in mathematics literacy. One solution to these problems is to improve students learning by integrating mathematical literacy components. Before improving the students learning, it is necessary to analyze the needs of students in learning to know the right steps to improve it.

Trigonometry is a branch of mathematics that studies triangles and trigonometric functions such as sines, cosines, and tangents. According to Sesanti, trigonometry is supporting material for other courses, such as integral calculus, multiple variable calculus, advanced calculus, algebraic structure 1 and differential equations [6]. Therefore, students must be able to master the concepts of trigonometry to understand other subjects. Trigonometry material is an abstract material that is difficult to understand because not all students are familiar with the material. Besides, students often find it difficult when facing the material or problems related to trigonometry. Trigonometry in higher education is given in mathematics study programs and other study programs which are applied using trigonometry, such as biology study programs, and so on. Trigonometric learning will be less effective in less conducive conditions. Based on the situations, it is necessary to analyze the needs of students in trigonometry courses to improve their learning.

Based on the problems above, the purpose of this study is to describe the results of the analysis of student-needs in trigonometric learning.

2. Research Method

The research is qualitative research using case study approach. Qualitative research according to Bogdan and Biklen defined as one of the research procedures that produces descriptive data in the form of speech or writing about the observed subject's behaviour [7]. While the case study approach is one of the approaches to qualitative research based on human understanding and behaviour based on differences in values, beliefs and *scientific theory* [8]. In the research, a case study was conducted in the Mathematics Education study program at University of Muhammadiyah Semarang, the research subject are the students itself.

The method used is a needs analysis using observation and interview techniques. In the analysis, researchers identify priority needs that must be met to obtain effective trigonometric learning. There are three stages of needs analysis in the study, those are the preparation phase, data collection, and data analysis and interpretation with the following description:

a. Preparation phase
   1) Formulation and identification of problems.
   2) Direct observation and review at the location of the problem.
   3) Determination of data requirements and data sources.
b. Data collection stage
   1) Direct survey to the field (observation method).

2) Interview with sources to obtain data (interview method).

c. Data analysis and processing stage

1) Review information or problems based on the results of data collection.
2) Review the relevant information about the group.
3) Conduct a descriptive analysis under the type of information.

The population in this study were all students of Mathematics Education study programs at the University of Muhammadiyah Semarang. The sampling technique is *purposive sampling* which means the technique of sampling data sources using certain considerations [9]. The sample in this study were students of the Mathematics Education Study Program at the Muhammadiyah Semarang University who were currently receiving trigonometry courses.

3. Results and Discussion

This chapter will describe the analysis of trigonometric learning needs which will be described in 3 stages, namely the preparation phase, the data collection stage, and the data analysis and interpretation stage.

a. Preparation phase

The preparation phase is the initial activity before collecting and analyzing data. This stage begins by formulating and identifying problems. The problems in this study can be identified as follows: 1) the quality of education in mathematics (mathematics literacy) at the international level through the PISA is in a low category, 2) mathematics learning so far has not supported the growth of the mathematics students, 3) Trigonometric material is one of the material that is difficult to understand because it is an abstract subject, and 4) students often find it difficult when faced the material or problems related to trigonometry. From the identification above, the problem formulation is: how the results of the need-analysis in trigonometry learning?

Second, direct observation and observation at the location of the problem. Observations were made in the mathematics education study program at the Muhammadiyah Semarang University. The results of observations and reviews as stated in the curriculum that has been prepared by the mathematics education study program at the Muhammadiyah Semarang University there is trigonometry material during semester 3. Students of the study program come from different backgrounds, abilities, and ways of learning. Students not only come from high school graduates, but there are also MA and SMK graduates with various majors. Due to the background, the ability of students in mathematics is varied.

Based on these observations, the next step in the preparation phase is the determination of data requirements and data sources. Data needed in this study were planning for the implementation of learning needs, the involvement of students in learning trigonometry, and possible barriers to learning. The source of the data comes from lecturers and students of the mathematics education study program at the Muhammadiyah Semarang University who are currently learning trigonometry material.

b. Data collection stage

The next stage is the data collection stage. At this stage, data collection was done using the method of observation and interviews with data sources. The results of observations regarding the planning of implementing learning needs can be described in detail the objectives of trigonometry learning as follows:

Competency standards: Students can use trigonometric concepts to solve relevant problems.

Basic competence :

1) Perform algebraic manipulation in technical calculations related to comparisons, functions, equations, and trigonometric identities.
2) Designing mathematical models of problems relating to comparisons, functions, equations, and trigonometric identities.
3) Solve mathematical models of problems related to comparisons, functions, equations, trigonometric identities, and their interpretation.

Indicator:

1) Trigonometric comparisons study.
2) Define a trigonometric ratio of an angle on the right triangle.
3) Determine the value of trigonometric comparisons from a special angle.

4) Determine the trigonometric comparison value of the angles in all quadrants.
5) Discuss and get to know the trigonometric comparison ratio of related angles.
Learning objectives :
1) Students can study trigonometric comparisons.
2) Students can define the trigonometric ratio of an angle on the right triangle.
3) Students can determine the value of trigonometric comparisons from a special angle.
4) Students can determine trigonometric comparison values from the angle in all quadrants.
5) Students can discuss and recognize the formula of trigonometric ratio related angles.

From the results of observations on trigonometry learning obtained several per problems, namely :

1) the learning process tends to go in the same direction using the expository method. Learning was still lecturer-centred in which the lecturer explains the material, accompanied by examples and student notes. The problem is that not all students are currently recording material taught by lecturers. When given a matter of practice, the lecturer does not provide opportunities for students to interact with other students. The students being passive in the learning process. Besides, students' reasoning abilities are not good yet because they tend to rely on material and answers on lecturers;
2) lecturer-centred learning cause most students, especially those who sit in the back row doing their activities, such as chatting with friends, opening youtube in mobile applications, and so forth;
3) the limitations of students in submitting conjectures and analyzing mathematical situations in the trigonometric learning process. This can be seen when the lecturer gives a question about trigonometry application in daily life. Only a few students can solve it.

The obtained data as results of interviews with several students who were taking trigonometry learning are as follows:

1) when the lecturer gives time to take notes of the lecturer's explanation on the *whiteboard*, most students prefer to take a picture of it.

   Question 1: What is the reason you prefer to take notes in the form of photographs rather than directly record them in a book?
   Student A: We can share it with friends, especially if take notes stays longer in the book.
   Student B: If notes in the form of photos can be easily carried anywhere. When I need it, I can open notes anywhere.
   Student C: I'm rather lazy to write notes in a book. If only photographed, when others take notes, I can open social media or chat with friends.
   Student D: The time given to take notes is limited, so if I take notes immediately, the notebooks become sloppy.

   Question 2: will the notes in the photo be transferred to the notebook?
   Student A: If I have the chance to move it to the notes.
   Student B: sometimes transferred to a notebook. But often I keep it in the cellphone gallery.
   Student C: If there is spare time in the boarding house, the notes that I photograph are transferred to the notebook.
   Student D: I moved it in a neat and colourful notebook to make it easier to memorize.

2) student-centred learning let the students busy with activities out of lessons.

   Question 1: why not pay attention to the lecturer when explaining trigonometry material?
   Student E: The learning is boring, makes me feel sleepy, so I chat with friends to get rid of sleepiness.
   Student F: learning less attractive, better open social media alone.
   Student G: I prefer to open material on the internet because it's clearer.

   Question 2: What kind of trigonometric learning do you want?
   Student E: I love interactive learning and makes the learning atmosphere come alive.
   Student F: I prefer learning with audiovisual media or teaching aids because with media, I can understand the benefits of trigonometric learning and its applications in life.

Student G: The trigonometric learning that I want is learning that allows me to understand the whole material.

3) only a few number of students can solve the questions in story form.

Question: What difficulties do you face in solving story problems?
Student H: I am confused about the formula I will use.
Student I: When faced a story problem, I had difficulty determining what was known and asked.
Student A: I always feel confused when determining variables.
Student K: I am often confused when given different questions from the example given by the lecturer.

c. Data analysis and interpretation phase

The results of observations and interviews that have been described obtained findings that can be seen in Table 1 as follows.

Table 1. Observation and Interview Findings Tables in Trigonometry Learning

Finding	
Trigonometry Learning	College student
1) Learning still uses expository and monotonous methods that are centred on lecturers	1) Students prefer to take *whiteboard* photos containing explanations of trigonometric material
2) More emphasis on notes than student understanding	2) Students feel bored during learning so that they do other activities
	3) When given a story problem, students have difficulty in determining the formula and applying it in problem-solving, determining guesses, and analyzing mathematical situations

Problems begin with trigonometric learning using expository methods. Suyitno stated that the expository method is a method of delivering material to students by lecturing and explaining the material, giving examples of questions accompanied by questions and answers, while students only listen and take notes [10]. The characteristics of expository learning, among others, are done by conveying material verbally and the material delivered is ready-made material, such as data or facts, certain concepts that must be memorized so that they do not require students to think again [11]. From the understanding and characteristics, it can be concluded that learning by the expository method emphasizes more on memorizing the material and recording explanations from the teacher. Student activities when the lecturers deliver material verbally are just listening and taking notes. The method is not suitable to be applied to students who are digital generation, where the learning process of digital generation always seeks all information related to trigonometry material: data, facts, and concepts easily through search engines on the internet [12]. This is shown from the observation on learning trigonometry using the expository method, students prefer to do other activities, such as open their social media, mingle with other students when the lecturer delivering the material. When the lecturer allows taking notes, mostly students documented material with the camera phone. This behaviour is contradictory to research conducted by Saharia, Tahmir, and Djam'an which states that recording material delivered by lecturers is one of the student's learning activities that excellent in mathematics learning because taking notes will make it easier for students to recall and relearn the material presented lecturer [13]. Summary of observations about student behaviour in trigonometric learning with expository methods shows the low motivation of students in participating in learning because of the contradiction with some motivational characteristics proposed by Brow [14] and Sardiman [15], including 1) being attracted to teachers by not showing indifferent attitude, 2) high enthusiasm for learning, 3) always remembering and relearning the material presented by lecturers, and 4) diligently facing the task .

The next finding is the difficulty of students in solving question in the form of story. Most students have not thought systematically seen from how to solve a story problem that is not following the steps because several steps are not understood by students, those are: determining the formula and applying it in solving problems, determining guesses, and analyzing

mathematical situations. Systematic thinking is the ability to think is most students to do or accomplish a task under the order, scales, steps, or proper planning, effective, and efficient [16]. Mathematical reasoning ability is a stage of high-level mathematical thinking that includes the capacity to think logically and systematically [17]. Steps that are not yet understood by students are included in the indicators of mathematical reasoning ability according to the PPPG Team [18], those are: 1) presenting mathematical statements in writing, 2) submitting allegations, and 3) carrying out mathematical manipulations. The step is also included in the indicators of the ability to understand concepts according to Permendikbud No. 58 of 2014 [19], those are: 1) restating the concepts that have been learned, 2) identifying concepts, 3) applying concepts logically, and 4) presenting concepts in various forms of mathematical representation. From the description above, students have not been able to think systematically, so the reasoning ability and the ability to understand mathematical concepts are low.

A discussion of these facts can be analyzed that the students-needs in trigonometry learning based on the results of interviews and literature that has been done before. The results of interviews with several students, the students want a learning process that helps them to understand the material as a whole, interactively, and apply learning media. Abidin and Saputro [20] stated that it is necessary to develop learning innovations that implement learning strategies that can increase student motivation and understanding. According to Hamalik [21], the use of instructional media in the teaching and learning process can arouse student motivation. This is according to research conducted by Siswanah [22] where the use of animation media in learning can arouse desires, interests, and enhance student motivation. Learning that implements learning innovations by applying learning models combined with learning media can improve mathematical reasoning abilities and understanding abilities of concepts, such as the results of research from Manah, Ariyani, and Kartono [23] which state that the application of *Flashcard*-assisted *Discovery Learning* can improve trigonometric reasoning abilities. Muchlis and Maizora's research [24] shows an increased understanding of the concept of trigonometry material in the application of learning with the Constructivism approach assisted by *Macromedia Flash 8*.

4. Conclusions

Based on the analysis, the conclusion is the student-needs in trigonometric learning are the development of learning innovations by implementing learning media and strategies or models. Learning innovations can also be developed in a learning model that integrated with instructional media that can improve students' motivation and reasoning abilities and understanding concepts.

References

[1] Law No. 20 of 2003 concerning the National Education System.
[2] Dinni, HN: HOTS (High Order Thinking Skills) and its Relationship with Mathematical Literacy Ability. PRISM 1. Pages 170-176 (2018)
[3] Oktaviyanthi, R., Agus, RN and Supriani, Y .: PISA Mathematics Framework in Searching Student Mathematical Literacy Skills. Journal of Education STKIP Kusuma Negara, (7) 1, p. 77-85 (2015)
[4] OECD. Data Program for International Student Assessment. [Online] http://www.oecd.org/pisa/data/ (2018)
[5] Balitbang : PISA International Survey. [On line]. Available at: http://litbang.kemdikbud.go.id/index.php/survei-international-pisa . Accessed January 24, 2015 (2011)
[6] Sesanti, NR : Application of Bruner's Theorem to Trigonometry Learning. *Journal of Educational Inspiration* . (2015)
[7] Bogdan, R. & Biklen, S.: Qualitative Research for Education. Allyn and Bacon, Boston, MA (1992)
[8] Borbasi, S: Navigating the maze of nursing research : An interactive learning adventure. Elsevier , Australia (2004)
[9] Sugiyono: Quantitative, Qualitative, and R&D Research Methods. Alfabeta Publisher, Bandung (2017)

[10] Suyitno, A: Fundamentals and Process of Learning Mathematics. Unnes, Semarang (2004)
[11] Sanjaya, W.: Learning Strategies Oriented in Educational Process Standards. Kencana Prenada Media Group, Jakarta (2007)
[12] Ministry of Education and Culture: Parents' Education Series: Educating Children in the Digital Age. Ministry of Education and Culture, Jakarta (2016)
[13] Saharia, Tahmir, S., & Djam'an, N.: Analysis of Student Achievement Learning Activities in Mathematics Learning. Issues in Mathematics Education, Vol. 1, No. 2, pp. 84-90 (2017)
[14] Syahwani, U.: Use of Media and Provision of Motivation in Learning Can Improve Learning Outcomes. Thesis. FKIP UNTAN, Pontianak (1997)
[15] Sardiman, AM: Interaction & Motivation of Teaching and Learning. PT. Bumi Aksara, Jakarta (2008)
[16] Tatag: Level of Student's Creative Thinking in Classroom Mathematics. Educational Research and Review, 6 (7) (2009)
[17] Yaniawati, RP: Alternative E-learning Contemporary Learning. Arfino Raya, Bandung (2010)
[18] Dwiningrum, S., Mardiyana, & Pramudya, I.: Analysis of Mathematical Reasoning Capabilities in the Material of Straight Line Equations Judging From the Personality Types of Class V III Students of State Junior High School 2 Ngemplak Boyolali . Proceedings of the Mathematics and Mathematics Education Seminar. Thing. 158-168 (2016)
[19] Arrahim & Widayanti, N.: Comparison of Concept Understanding of Class IV Students by Using Problem Based Learning (PBL) Models and Realistic Mathematic Education (RME) Models in Mathematics Subjects at SDIT Darul Hasani, Bekasi District. PEDAGOGIK Vol. VI No. 2, Hal. 134-143 (2018)
[20] Abidin, Z. & Saputro, TME: Efforts to Increase Students' Motivation and Understanding of Geometry and Measurement Materials through "Remase" Activities at SMP 33 Semarang . Kreano Journal Vol. 2 No. 2 things. 133-141 (2011)
[21] Arsyad, A.: Learning Media. Rajawali Press, Jakarta (2005)
[22] Siswanah, E.: The Use of Animation Media in Trigonometry Learning to Improve Student Learning Outcomes of Tadris Mathematics I AIN Walisongo Semarang . Journal of Pheomenon Vol. 3 No. 2, Hal. 5-17 (2013)
[23] Manah, NK, Ariyani, A., & Kartono: Improving the Trigonometric Reasoning Ability of Class XI MIPA 3 Students in SMA Negeri 11 Semarang through the Flashcard Assisted Learning Model in the Material of Trigonometry Formulas . PRISMA 2. Hal. 883-892 (2019)
[24] Muchlis, EE & Maizora, S.: Efforts to Improve the Ability to Understand Trigonometry Concepts through Constructivism Approach with Macromedia Flash 8 Assisted Students in Mathematics Education Study Program FKIP Bengkulu University . Journal of Mathematics Education Research Jakarta , Vol. 1, No. 1, p. 39-44 (2018)